

International Conference of Modeling of Casting, Welding and Advanced Solidification Processes X, Sandestin, Florida, May 25-30, 2003

NUMERICAL CALCULATION OF THE MORPHOLOGY OF A SOLID/LIQUID INTERFACE NEAR AN INSOLUBLE PARTICLE

Adrian V. Catalina¹, Doru M. Stefanescu², and Subhayu Sen¹

¹USRA/SD46 NASA Marshall Space Flight Center, Huntsville, AL 35812, USA

²The University of Alabama, P.O. Box 870202, Tuscaloosa, AL 35487, USA

Abstract

A numerical mathematical model capable of accurately describing the evolution of the shape of the solid/liquid interface in the proximity of a foreign particle is presented in this paper. The model accounts for the influence of the temperature gradient and the Gibbs-Thomson and disjoining pressure effects. It shows that for the systems characterized by $k_P < k_L$ the disjoining pressure causes the interface curvature to change its sign in the close-contact particle/interface region. It also shows that the increase of the temperature gradient diminishes the effect of the disjoining pressure. Calculated critical solidification velocities for the pushing/engulfment transition are compared with experimental measurements performed in microgravity conditions.